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(54) METHOD OF MANUFACTURING ELECTRONIC CIRCUIT DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a method of manufacturing an electronic circuit device which allows the bonding of bumps with a high bonding strength without generating a mechanical damage such as crater rings.
SOLUTION: The electronic circuit device is a mount substrate 2 mounted with a semiconductor device 1, The mount substrate 2 is a substrate 20 formed of a glass epoxy-based material which is formed with electrodes 21, The semiconductor device 1 has a plurality of bumps 12 which are formed in nearly a polygon on a semiconductor

chip so that they may be connected to a circuit pattern of the semiconductor chip, First, the semiconductor device 1 is placed on the mount substrate 2 with the bumps 12 and the electrodes 21 being aligned with each other, Next, ultrasonic vibration is applied in a direction Dv which is different from any direction parallel with any side of the polygon formed by the bumps arranged in nearly a polygon, for example, in the diagonal direction of the semiconductor chip, with the bumps 12 and the electrodes 21 being adhered to each other by pressing the semiconductor device 1 from the upper surface. The bumps 12 and the electrodes 21 are heat-fused by the heat generated by the ultrasonic vibration.

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CLAIMS

[Claim(s)]
[Claim 1] The semiconductor device which has two or more bumps arranged and formed on said semiconductor chip the shape of an abbreviation polygon, and in the shape of a straight line so that it may connect with the circuit pattern of a semiconductor

chip The process which is the manufacture approach of the electronic-circuitry equipment mounted on the mounting substrate which has an electrode, carries out alignment of said bump and said electrode, and **** said semiconductor device on said mounting substrate, Parallel with the side of the polygon which the bump arranged in the shape of [said] an abbreviation polygon constitutes, sticking said bump and said electrode in the different direction also from the direction of the gap which is not Or the manufacture approach of electronic-circuitry equipment of having the process which impresses supersonic vibration in a direction parallel to the straight line which the bump arranged in the shape of [said] a straight line constitutes, and the different direction to said semiconductor device.

[Claim 2] The manufacture approach of the electronic-circuitry equipment according to claim 1 which is the direction where the direction which impresses supersonic vibration to said semiconductor device equalizes the reaction which acts on per said bump piece at the time of said supersonic vibration impression.

[Claim 3] The direction which equalizes the reaction which acts on per said bump piece is the manufacture approach of the electronic-circuitry equipment according to claim 2 which is the direction where the distance between the bumps who met in the direction which impresses said supersonic vibration becomes larger than the distance between the minimum bumps.

[Claim 4] The manufacture approach of electronic-circuitry equipment according to claim 1 that the direction which said bump is stationed at the abbreviation rectangle and impresses supersonic vibration to said semiconductor device on said semiconductor device is the direction of the diagonal line of said semiconductor chip.

[Claim 5] The manufacture approach of the electronic-circuitry equipment according to claim 1 using the mounting substrate with which wiring was formed in the substrate which consists of a glass epoxy system ingredient as said mounting substrate.

[Claim 6] The manufacture approach of electronic-circuitry equipment according to claim 1 using torsional vibration as an approach of impressing supersonic vibration in a direction parallel to the straight line which the bump arranged a different direction also from the side of the polygon which the bump arranged in the shape of [said] an abbreviation polygon constitutes, and the direction of the gap which is not parallel, or in the shape of [said] a straight line constitutes, and the different direction to said semiconductor device.

[Claim 7] The manufacture approach of the electronic-circuitry equipment according to claim 6 using the oscillation which compounded the oscillation of the direction of a normal over said mounting substrate front face with said torsional vibration further as an approach of impressing supersonic vibration to said semiconductor device.

[Claim 8] The semiconductor device which has two or more bumps arranged and formed on said semiconductor chip in the shape of an abbreviation polygon so that it may connect with the circuit pattern of a semiconductor chip The process which is the

manufacture approach of the electronic-circuitry equipment mounted on the mounting substrate which has an electrode, carries out alignment of said bump and said electrode, and **** said semiconductor device on said mounting substrate, It has the process which impresses supersonic vibration to said semiconductor device, sticking said bump and said electrode. The manufacture approach of the electronic-circuitry equipment which makes the corner of the polygon which the bump arranged in the shape of [said] an abbreviation polygon constitutes, or the bump near the corner the dummy bump with whom only mechanical junction is presented.

[Claim 9] The semiconductor device which has two or more bumps arranged and formed on said semiconductor chip in the shape of an abbreviation polygon so that it may connect with the circuit pattern of a semiconductor chip The process which is the manufacture approach of the electronic-circuitry equipment mounted on the mounting substrate which has an electrode, carries out alignment of said bump and said electrode, and **** said semiconductor device on said mounting substrate, The manufacture approach of electronic-circuitry equipment of having the process which intersects perpendicularly with each side of the polygon which the bump arranged in the shape of [said] an abbreviation polygon constitutes while sticking said bump and said electrode and which divides into multiple times and impresses supersonic vibration to said semiconductor device for every direction.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] Especially this invention relates to the manufacture approach of electronic-circuitry equipment of having mounted the semiconductor device which has a miniaturization and the package gestalt by which densification was carried out on the mounting substrate, about the manufacture approach of electronic-circuitry equipment.

[0002]

[Description of the Prior Art] Research and development have been made as a technical problem with how important to raise the component-mounting consistency on a mounting substrate, while the demand to the miniaturization of portable electronic devices, such as a digital camcorder, a digital cellular phone, or a notebook computer, thin-shape-izing, and lightweight-izing has realized cutback-ization of 70 percent in semiconductor devices, such as VLSI in recent years, in three years, in order to respond [which is becoming strong steadily] to this.

[0003] As a package gestalt of a semiconductor device, conventionally The lead inserting type (THD:Through Hall Mount Device) which inserts and mounts lead wire

in the through hole established in printed circuit boards, such as DIP (Dual Inline Package) or PGA (Pin Grid Array), The surface mount mold (SMD:Surface Mount Device) which solders lead terminals, such as QFP (Quad Flat Package) or TCP (Tape Carrier Package), on the surface of a substrate, and mounts them has been used. Furthermore, it has shifted to the package gestalt called the chip-size package (referred to also as CSP:Chip Size Package and FBGA (Fine-Pitch BGA)) which brought package size close to the magnitude of a semiconductor chip infinite for the miniaturization of equipment, and densification.

[0004] In order to realize miniaturization of the further equipment, and densification, the method of mounting a naked semiconductor chip (bare chip) in a mounting substrate was developed. There is a flip chip gestalt which connects a semiconductor chip electrode and mounting substrate electrode electrically and mechanically by the bump by the face down method which forms the bump (projection electrode) in the COB (Chip On Board) gestalt [which makes an electrode forming face bare chip mounting technology for a semiconductor chip on the top face, carries out die bond on a mounting substrate, and connects a semiconductor chip electrode and mounting substrate electrode electrically by wirebonding after that], and chip electrode beforehand, and turns a bump forming face to a mounting substrate.

[0005] In the above-mentioned flip chip gestalt, the approach of forming a bump in a semiconductor chip is roughly divided, and has a stud bump method and solder bump methods, such as gold. A stud bump is formed on a semiconductor chip of wirebonding which used the golden wire etc., and, on the other hand, a solder bump is formed by the plating method, the vacuum evaporationo method, a ball imprint method, etc. The above-mentioned stud bump method is mainly applied to the so-called semiconductor chip of the peripheral pad in which the pad was formed near the chip periphery so that the periphery section of a circuit pattern may be surrounded, and the solder bump method is widely applied to the semiconductor chip containing the semiconductor chip which is arranged all over a semiconductor chip besides the semiconductor chip of a peripheral pad and which was formed into the area pad.

[0006] The approach of forming bump junction by impressing supersonic vibration to a semiconductor chip or a mounting substrate is developed pressing on a mounting substrate so that a bump and the electrode of a mounting substrate may stick the semiconductor chip which has the bump formed by an above-mentioned stud bump method or an above-mentioned solder bump method. The above-mentioned mounting approach is explained below with reference to a drawing.

[0007] Drawing 1 (a) is the sectional view of the semiconductor device mounted in the above-mentioned mounting approach, and drawing 1 (b) is a top view. The pad electrode 11 which consists of aluminum etc. is formed so that the periphery section of the electronic-circuitry pattern of a semiconductor chip 10 may be surrounded, and it may connect with the above-mentioned electronic-circuitry pattern [near the chip

periphery]. The pad electrode 11 above-mentioned forming face is covered by the surface protective coat which consists of the silicon nitride layer or polyimide layer which is not illustrated [for example,], and pad electrode 11 part is carrying out opening. In the above-mentioned opening, the bump 12 who consists of conductors, such as gold, is formed, and it is arranged by the square configuration. The semiconductor chip 1 of a peripheral pad mold is constituted as mentioned above.

[0008] Drawing 20 (a) is the side elevation of the process which mounts the above-mentioned semiconductor device 1, and drawing 20 (b) is an important section top view. The land (electrode) 21 covered by plating processing by nickel, gold, etc. is formed in the location corresponding to the bump 12 formation location of the semiconductor device 1 mounted on the top face of the substrate 20 which consists of a ceramic system ingredient in the mounting substrate 2 which mounts the above-mentioned semiconductor device 1 in the front face of a conductive layer which consists of copper etc. It connects with a land 21 and has the printed-circuit section which is formed on the front face of a substrate 20, a rear face, or both sides and which is not illustrated.

[0009] It is Direction DV by the vibrator 4 connected to the horn 3 where made the bump 12 of the above-mentioned semiconductor device 1, and the land 21 of the mounting substrate 2 correspond, it mounted, it impressed the pressure P for the top face of a semiconductor device 1 by the heights (bonding tool) 3a front face of a horn 3 and a bump 12 and a land 21 are stuck, in order to mount a semiconductor device 1. The supersonic vibration which carries out the amplitude is generated. At this time, a horn 3 is the above-mentioned direction DV. Supersonic vibration is impressed to the adhesion part of a land 21 with a bump 12, amplifying the amplitude of supersonic vibration. Here, it is the oscillating direction DV of supersonic vibration. It is the direction or the parallel direction which intersects perpendicularly to a bump's 12 array direction. Above ultrasonic impression equipment can also use the equipment of both the support type indicated by the others and patent printing official report No. 2915350 and JP,11-45912,A. [type / like drawing 20 (a) / piece support]

[0010] In the above, the horn 3 is beforehand heated by about 100 degrees C, and frictional heat occurs in the adhesion part of a land 21 with a bump 12 by having impressed the further above-mentioned supersonic vibration. Although the temperature of 209 degrees C or more is required for a bump 12 and a land 21 to form bump connection by metallic bond when a bump 12 consists of gold and land 21 front face is gold-plated, the temperature in which the temperature of the adhesion part of a land 21 carries out the above-mentioned metallic bond to a bump 12 with the above-mentioned frictional heat can be exceeded, and a bump 12 and a land 21 can be connected mechanically and electrically. Thus, the electronic-circuitry equipment which mounted the semiconductor device 1 as shown in drawing 21 in the mounting substrate 2 can be manufactured. It is used for a semiconductor device 1 and the mounting substrate 2 for

between by the electronic-circuitry equipment which mounted the above-mentioned semiconductor device 1 in the mounting substrate 2, closing to them with resin.

[0011] In the approach of forming and mounting bump junction by impressing the above-mentioned supersonic vibration, a bump's bonding strength can be raised by the approaches of enlarging the amplitude of supersonic vibration, such as heightening the pressure which presses a semiconductor device or lengthening supersonic vibration impression time amount.

[0012] However, as mentioned above, in order to raise a bump's bonding strength, when the pressure which presses a semiconductor device when the amplitude of supersonic vibration is enlarged is heightened, or when supersonic vibration impression time amount is lengthened, the danger that a crack will occur is in a bump joint. Especially the crack K generated in the pad electrode 11 which consists of aluminum currently formed on the semiconductor chip 10 as shown in drawing 22 is called cratering. Therefore, it is necessary to adjust supersonic vibration reinforcement and to secure a bump's bonding strength so that mechanical damages, such as cratering, may not occur.

[0013]

[Problem(s) to be Solved by the Invention] However, there was a problem that the junction force is beyond a desired value and the case where it cannot be made to join on condition that if for a serious mechanical damage not to occur produces all bumps as mentioned above conventionally in a semiconductor device with which two or more bumps are arranged by the configuration of arbitration.

[0014] For example, the bump 12 who shows drawing 1 (b) sets to the semiconductor chip arranged by the rectangle configuration in one train at the periphery section of a semiconductor chip. If junction conditions are optimized so that all bumps' bonding strength may be carried out beyond a predetermined value when the oscillating direction of supersonic vibration is carried out in the same direction as the side of the arbitration of a rectangle configuration It becomes easy to generate the above-mentioned cratering by the bump stationed in the side of the supersonic vibration impression direction and the direction which intersects perpendicularly, especially the bump of the corner of a rectangle configuration. Moreover, if junction conditions are reversely set up so that the above-mentioned cratering may not occur about all bumps, the bonding strength of the bump stationed the side parallel to the supersonic vibration impression direction will no longer be obtained enough. The above-mentioned phenomenon becomes remarkable when a substrate with the degree of hardness of a glass epoxy system ingredient etc. low especially as a mounting substrate is used.

[0015] This invention is made in view of the above-mentioned problem , and this invention aims at offering the manufacture approach of the electronic circuitry equipment which bonding strength is secured and can join a bump , without two or more bumps making all the pad sections connected electrically generate mechanical damages , such as cratering , in the approach of mounting in a mounting substrate by

ultrasonic jointing in the semiconductor device arranged by the configuration of arbitration .

[0016]

[Means for Solving the Problem] In order to attain the above-mentioned object, the manufacture approach of the electronic-circuitry equipment of this invention The semiconductor device which has two or more bumps arranged and formed on said semiconductor chip the shape of an abbreviation polygon, and in the shape of a straight line so that it may connect with the circuit pattern of a semiconductor chip The process which is the manufacture approach of the electronic-circuitry equipment mounted on the mounting substrate which has an electrode, carries out alignment of said bump and said electrode, and **** said semiconductor device on said mounting substrate, Parallel with the side of the polygon which the bump arranged in the shape of [said] an abbreviation polygon constitutes, sticking said bump and said electrode in the different direction also from the direction of the gap which is not Or it has the process which impresses supersonic vibration in a direction parallel to the straight line which the bump arranged in the shape of [said] a straight line constitutes, and the different direction to said semiconductor device.

[0017] The manufacture approach of the electronic-circuitry equipment of above-mentioned this invention is a direction where the distance between the bumps who met in the direction where the direction which impresses supersonic vibration to said semiconductor device equalizes the reaction which acts on per said bump piece at the time of said supersonic vibration impression, for example, the direction which impresses said supersonic vibration, becomes larger than the distance between the minimum bumps suitably.

[0018] The direction of the manufacture approach of the electronic-circuitry equipment of above-mentioned this invention where said bump is stationed at the abbreviation rectangle, and impresses supersonic vibration to said semiconductor device suitably on said semiconductor device is the direction of the diagonal line of said semiconductor chip.

[0019] The manufacture approach of the electronic-circuitry equipment of above-mentioned this invention uses suitably the mounting substrate with which wiring was formed in the substrate which consists of a glass epoxy system ingredient as said mounting substrate.

[0020] The manufacture approach of the electronic-circuitry equipment of above-mentioned this invention uses torsional vibration as an approach of impressing supersonic vibration in a direction suitably parallel to the straight line which the bump arranged a different direction also from the side of the polygon which the bump arranged in the shape of [said] an abbreviation polygon constitutes, and the direction of the gap which is not parallel, or in the shape of [said] a straight line constitutes, and the different direction to said semiconductor device. The oscillation which compounded

the oscillation of the direction of a normal over said mounting substrate front face with said torsional vibration further as an approach of impressing supersonic vibration to said semiconductor device, still more suitably is used.

[0021] The manufacture approach of the electronic-circuitry equipment of above-mentioned this invention is the manufacture approach of electronic-circuitry equipment of having mounted the semiconductor device which has two or more bumps arranged and formed on the semiconductor chip the shape of an abbreviation polygon, and in the shape of a straight line on the mounting substrate with which the electrode was formed in the substrate which consists of a glass epoxy system ingredient etc., carries out the alignment of a bump and the electrode, and **** a semiconductor device on a mounting substrate first so that it may connect with the circuit pattern of a semiconductor chip. Next, supersonic vibration is impressed in a direction parallel to the straight line which the bump arranged a different direction from all of a direction parallel [sticking a bump and an electrode] to the side of the polygon which the bump arranged in the shape of an abbreviation polygon constitutes, or in the shape of [said] a straight line constitutes, and the different direction to a semiconductor device. The direction which impresses supersonic vibration to the above-mentioned semiconductor device is made into the direction where the distance between the bumps who met in the direction which equalizes the reaction which acts on per bump piece at the time of supersonic vibration impression, for example, the direction which impresses supersonic vibration, becomes larger than the distance between the minimum bumps. When said bump is stationed on the semiconductor device at the abbreviation rectangle, the direction which impresses supersonic vibration to a semiconductor device considers as the direction of the diagonal line of a semiconductor chip.

[0022] With the side of the polygon which the bump arranged in the shape of an abbreviation polygon constitutes, parallel moreover, in the different direction also from the direction of the gap which is not Or as an approach of impressing supersonic vibration in a direction parallel to the straight line which the bump arranged in the shape of a straight line constitutes, and the different direction to a semiconductor device, torsional vibration may be used and the oscillation which compounded the oscillation of the direction of a normal over a mounting substrate front face to this torsional vibration is used further. Here, torsional vibration is an oscillation to the direction which rotates the center of gravity of the semiconductor chip to mount etc. as a core.

[0023] According to the manufacture approach of the electronic-circuitry equipment of above-mentioned this invention, the direction of the diagonal line of a semiconductor chip etc., In the different direction from all of a direction parallel to the side of the polygon which the bump arranged in the shape of an abbreviation polygon constitutes Or since supersonic vibration is impressed in a direction parallel to the straight line which the bump arranged in the shape of a straight line constitutes, and the different direction [when it is the direction where the reaction which acts on per bump piece at

the time of supersonic vibration impression is equalized and a substrate with the degree of hardness of a glass epoxy system ingredient etc. low especially as a mounting substrate is used] It is possible to secure bonding strength and to join a bump, without making all the pad sections connected electrically generate mechanical damages, such as cratering.

[0024] In order to attain the above-mentioned object, moreover, the manufacture approach of the electronic-circuitry equipment of this invention The semiconductor device which has two or more bumps arranged and formed on said semiconductor chip in the shape of an abbreviation polygon so that it may connect with the circuit pattern of a semiconductor chip The process which is the manufacture approach of the electronic-circuitry equipment mounted on the mounting substrate which has an electrode, carries out alignment of said bump and said electrode, and **** said semiconductor device on said mounting substrate, Sticking said bump and said electrode, it has the process which impresses supersonic vibration to said semiconductor device, and let the corner of the polygon which the bump arranged in the shape of [said] an abbreviation polygon constitutes, or the bump near the corner be the dummy bump with whom only mechanical junction is presented.

[0025] In the approach of impressing supersonic vibration to the semiconductor device which has two or more bumps arranged and formed on the semiconductor chip in the shape of an abbreviation polygon according to the manufacture approach of the electronic-circuitry equipment of above-mentioned this invention, and forming bump junction Since the corner of a polygon configuration which is easy to receive mechanical damages, such as cratering, or the bump near the corner is made into the dummy bump with whom only mechanical junction is presented Even if cratering occurs by the dummy bump, junction conditions can be optimized so that a problem may not arise and bonding strength may be carried out to the bump except a corner or its near beyond a predetermined value. Therefore, it is possible to secure bonding strength and to join a bump, without making all the pad sections connected electrically generate mechanical damages, such as cratering, when a substrate with the degree of hardness of a glass epoxy system ingredient etc. low especially as a mounting substrate is used.

[0026] In order to attain the above-mentioned object, moreover, the manufacture approach of the electronic-circuitry equipment of this invention The semiconductor device which has two or more bumps arranged and formed on said semiconductor chip in the shape of an abbreviation polygon so that it may connect with the circuit pattern of a semiconductor chip The process which is the manufacture approach of the electronic-circuitry equipment mounted on the mounting substrate which has an electrode, carries out alignment of said bump and said electrode, and **** said semiconductor device on said mounting substrate, It has the process which intersects perpendicularly with each side of the polygon which the bump arranged in the shape of

[said] an abbreviation polygon constitutes and which divides into multiple times and impresses supersonic vibration to said semiconductor device for every direction, sticking said bump and said electrode.

[0027] In the approach of impressing supersonic vibration to the semiconductor device which has two or more bumps arranged and formed on the semiconductor chip in the shape of an abbreviation polygon according to the manufacture approach of the electronic-circuitry equipment of above-mentioned this invention, and forming bump junction Since it divides into multiple times and supersonic vibration is impressed to a semiconductor device for every direction which intersects perpendicularly with each side of the polygon which the bump arranged in the shape of an abbreviation polygon constitutes, the reaction which acts on each bump piece at the time of supersonic vibration impression is equalized. Therefore, it is possible to secure bonding strength and to join a bump, without making all the pad sections connected electrically generate mechanical damages, such as cratering, when a substrate with the degree of hardness of a glass epoxy system ingredient etc. low especially as a mounting substrate is used.

[0028]

[Embodiment of the Invention] Below, the gestalt of implementation of the manufacture approach of the electronic-circuitry equipment of this invention is explained with reference to a drawing.

[0029] 1st operation gestalt drawing 1 (a) is the sectional view of the semiconductor device mounted in this operation gestalt, and drawing 1 (b) is a top view. For example, the pad electrode 11 which consists of aluminum etc. is formed so that the periphery section of the electronic-circuitry pattern of the semiconductor chip 10 whose magnitude is 3mmx3mm and whose thickness is about 0.3mm may be surrounded, and it may connect with the above-mentioned electronic-circuitry pattern [near the chip periphery]. The pad electrode 11 above-mentioned forming face is covered by the surface protective coat which consists of the silicon nitride layer or polyimide layer which is not illustrated [for example,], and pad electrode 11 part is carrying out opening. In the above-mentioned opening, the bump 12 who consists of conductors, such as gold, is formed, and it is arranged by the square configuration by arrangement like drawing 6 (a1). For example, in the case of a golden stud bump (99.99% of gold), the bump whose path is 70-80 micrometers and whose height is about 50 micrometers can be formed by the wirebonding method using a golden wire. The number per a bump's semiconductor chip is made into 75 pieces. The semiconductor chip 1 of a peripheral pad mold is constituted as mentioned above.

[0030] Drawing 2 (a) is the side elevation of the process which mounts the above-mentioned semiconductor device 1, and drawing 2 (b) is an important section top view. Nickel, gold, etc. cover the front face of a conductive layer which consists of copper etc. by plating processing, for example, the land (electrode) 21 whose width of face is about 50 micrometers is formed in the location corresponding to the bump 12

formation location of the semiconductor device 1 mounted on the top face of the substrate 20 which consists of a glass epoxy system ingredient or a ceramic system ingredient in the mounting substrate 2 which mounts the above-mentioned semiconductor device 1. It connects with a land 21 and has the printed-circuit section which is formed on the front face of a substrate 20, a rear face, or both sides etc. and which is not illustrated.

[0031] In order to mount a semiconductor device 1, it mounts first by making the bump 12 of the above-mentioned semiconductor device 1, and the land 21 of the mounting substrate 2 correspond (****). It has the device in_which heights (bonding tool) 3a of a horn 3 adsorbs a semiconductor device 1 by attraction etc. in the above and in_which it does not illustrate, and a semiconductor device 1 is adsorbed and it mounts on the mounting substrate 2 so that the oscillating direction DV of supersonic vibration may turn into a direction which has a different include angle from all of directions parallel to the side of the square which the bump by whom it was arranged by the square configuration constitutes, such as the direction of the diagonal line of a semiconductor chip. Heights 3a of a horn 3 is formed so that it may have a predetermined include angle according to the include angle which adsorbs a semiconductor device 1.

[0032] In order for heights 3a of a horn 3 to draw in and adsorb a semiconductor device 1 so that it may become a different include angle from all of directions parallel to the side of the square which the bump arranged by the square configuration constitutes, such as the direction of the diagonal line of a semiconductor chip, in the above For example, the approach of conveying without leaning beforehand the horn 3 which has heights 3a and attraction hole 3b to the predetermined include angle, and leaning a semiconductor device 1, as shown in drawing 3 (a), Or as shown in drawing 3 (b), the horn 3 which has heights 3a and attraction hole 3b is not leaned, but can be realized by the approach of leaning and conveying a semiconductor device 1 at a predetermined include angle beforehand etc.

[0033] Next, it is Direction DV by the vibrator 4 connected to the horn 3 where it impressed the pressure P for the top face of a semiconductor device 1 by the heights 3a front face of a horn 3 and a bump 12 and a land 21 are stuck. The supersonic vibration which carries out the amplitude is generated. At this time, a horn 3 is the above-mentioned direction DV. Supersonic vibration is impressed to the adhesion part of a land 21 with a bump 12, amplifying the amplitude of supersonic vibration. The pressure P impressed to a horn is for example, 8kgf extent, and makes supersonic vibration to impress 0.3 seconds - 10W, 50kHz, amplitude [of 2 micrometers], and oscillation time amount 0.4 seconds.

[0034] In the above, the horn 3 is beforehand heated by about 100 degrees C, and frictional heat occurs in the adhesion part of a land 21 with a bump 12 by having impressed the further above-mentioned supersonic vibration. Although the temperature of 209 degrees C or more is required for a bump 12 and a land 21 to form bump

connection by metallic bond when a bump 12 consists of gold and land 21 front face is gold-plated, the temperature in which the temperature of the adhesion part of a land 21 carries out the above-mentioned metallic bond to a bump 12 with the above-mentioned frictional heat can be exceeded, and a bump 12 and a land 21 can be connected mechanically and electrically. Thus, the electronic-circuitry equipment which mounted the semiconductor device 1 as shown in drawing 4 (b) which is the sectional view and its important section enlarged drawing of drawing 4 (a) in the mounting substrate 2 can be manufactured.

[0035] The bump-land bonding strength when mounting in a table 1 on the above-mentioned junction conditions and the experimental result which investigated the existence of cratering were summarized with each ultrasonic-jointing experiment conditions. In addition, as shown in drawing 5 , bump-land bonding strength fixed the electronic-circuitry equipment which mounted the semiconductor device 1 in the mounting substrate 2, and pressurized in the parallel direction to the mounting substrate 2 etc. in semiconductor device (chip) 1 end face with the pawl J for die share on-the-strength measurement, and measurement of the die share reinforcement which measures reinforcement in case a semiconductor device (chip) 1 exfoliates performed it here. Moreover, the measuring method of cratering was performed by observing the rear face of the pad electrode 11 which penetrates the silicon of the base material of a semiconductor chip etc. with an infrared microscope, and consists of aluminum etc.

[0036]

[A table 1]

表1　超音波接合試験

	超音波接合実験条件				実験結果	
試料番号	超音波印加方向	圧力	振幅	発振時間	バンプ－ランド接合強度	クレータリング
1	対角線方向（本発明）	8 kgf	2 μm	0．3秒	可	発生なし
2	辺方向（従来例）	8 kgf	2 μm	0．3秒	優	一部発生（＊）
3	対角線方向（本発明）	8 kgf	2 μm	0．4秒	可	発生なし
4	辺方向（従来例）	8 kgf	2 μm	0．4秒	優	一部発生（＊）

（＊）超音波振動印加方向と直交する辺上のバンプに発生

[0037] Although bump-land bonding strength was excellent when it considered as the square side and parallel whose bump arranged by the square configuration constitutes the impression direction of supersonic vibration (conventional example), as shown in the above-mentioned table 1, cratering occurred by the bump on the side of the ultrasonic impression direction and the direction which intersects perpendicularly. On the other hand, when it considers as the square direction of the diagonal line where the bump arranged by the square configuration constitutes the impression direction of

supersonic vibration (this invention), reinforcement with sufficient bump-land bonding strength is obtained, and cratering was not generated.

[0038] it be possible to secure required bonding strength , to make dependability increase , and to make bump connection , without make all the pad sections electrically connect by impress supersonic vibration in the different directions from all of a direction parallel to the side of the square which the bump arranged by the square configuration to the semiconductor device constitute , such as the direction of the diagonal line of a semiconductor chip , generate mechanical damages , such as cratering , according to the manufacture approach of above electronic circuitry equipment .

[0039] In the above-mentioned operation gestalt, although the example of application to the bump array pattern arranged by the square configuration is explained, this invention is applicable also to the bump array pattern of other various configurations. Drawing 6 - drawing 8 are the mimetic diagrams having shown the applicable bump array pattern, and are explained in detail hereafter.

[0040] the C section enlarged drawing in drawing 6 (a1) and this drawing -- it is (a2) -- a bump 12 arranges [the periphery section of a semiconductor chip] in a rectangle configuration at one train -- having -- the bump array direction DB constituting -- **** -- the C section enlarged drawing in drawing 6 (b1) and this drawing -- it is (b2) -- A bump 12 is arranged by the rectangle configuration in the periphery section of a semiconductor chip at two or more trains (for example, three trains). the bump array direction DB constituting -- **** -- the C section enlarged drawing in drawing 6 (c1) and this drawing -- it is (c2) -- a bump 12 arranges one train in each rectangle configuration to the periphery section and the center section of the semiconductor chip, respectively -- having -- the bump array direction DB The constituted bump array pattern is shown.

[0041] moreover, the C section enlarged drawing in drawing 7 (d1) and this drawing -- it is (d2) -- a bump 12 shows the bump array pattern which is arranged all over [Y] a semiconductor chip and which was formed into the area pad, and arranges [the periphery section of a semiconductor chip] drawing 7 (e) in a polygon (for example, eight square shapes) configuration at one train -- having -- the bump array direction DB The constituted bump array pattern is shown.

[0042] Moreover, a bump 12 shows the abbreviation rectangle configuration pattern with which the bump of Z is removed in part by the rectangle configuration in the bump array pattern arranged in one train at the periphery section of a semiconductor chip, and, as for drawing 8 (f), shows the bump array pattern with which the bump 12 was arranged by one train in the shape of linear, as for drawing 8 (g).

[0043] When the direction where the impression direction of supersonic vibration differs from all of a direction parallel to the side of the polygon which these bumps constitute when the bump is arranged in the shape of an abbreviation polygon when it

mounts the semiconductor chip of each above-mentioned bump array pattern, or the bump is arranged in the shape of a straight line, it considers as a direction parallel to the straight line which these bumps constitute, and a different direction.

[0044] When the bump is arranged in the shape of an abbreviation polygon, it can set up so that the angle which the side of the polygon which a bump constitutes, and the direction of supersonic vibration make as a different direction from all of a direction parallel to the side of the polygon which these bumps constitute may become 20 degrees, 40 degrees, 60 degrees, or 80 degrees. It can set up, as well as the above when the bump is arranged in the shape of linear.

[0045] for example, as shown in drawing 9 (a1), when the bump is stationed on the semiconductor chip at the square configuration, as shown in drawing 9 (a2), the direction DV of supersonic vibration can be set up in the direction of each side of the square which a bump constitutes (the bump array direction DB1, DB2), and the different direction (for example, the bump array direction DB1 and DB2 -- respectively -- ** -- the direction which crosses at the include angle of 45 degrees).

[0046] moreover, as shown in drawing 9 (b1), when the bump is stationed on the semiconductor chip for example, at the equilateral-triangle configuration the direction (the bump array direction DB1, DB2, DB3) of each side of the square which a bump constitutes as shown in drawing 9 (b2), and a different direction (it crosses at the include angle of 30 degrees bump array direction DB2 and DB3 -- respectively -- ** --) [for example,] It is the direction DV of supersonic vibration to the bump array direction DB1 and the direction which intersects perpendicularly. It can set up.

[0047] When it mounts the semiconductor chip of each above-mentioned bump array pattern, when the bump is arranged in the shape of an abbreviation polygon, for every direction which intersects perpendicularly with each side of the polygon which the bump arranged in the shape of an abbreviation polygon constitutes, the impression direction of supersonic vibration may be divided into multiple times, and may impress supersonic vibration to a semiconductor device. It is possible to secure bonding strength and to join a bump also by this, without making all the pad sections connected electrically generate mechanical damages, such as cratering, since the reaction which acts on each bump piece at the time of supersonic vibration impression is equalized, when a substrate with the degree of hardness of a glass epoxy system ingredient etc. low especially as a mounting substrate is used.

[0048] For example, as shown in drawing 10 (a), when the bump is stationed on the semiconductor chip at the square configuration, the supersonic vibration impression directions DV1 and DV2 can be set up in the direction of each side of the square which a bump constitutes (the bump array direction DB1, DB2), and the direction which intersects perpendicularly, and supersonic vibration can be impressed to a semiconductor device in 2 steps for every direction.

[0049] For example, as shown in drawing 10 (b), when the bump is stationed on the

semiconductor chip at 8 square-shape configuration, the supersonic vibration impression directions DV1, DV2, and DV3 can be set up in the direction of each side of eight square shapes which a bump constitutes (the bump array direction DB1, DB2, DB3), and the direction which intersects perpendicularly, and supersonic vibration can be impressed to a semiconductor device in 3 steps for every direction.

[0050] In the above, although the gestalt of various operations of the invention in this application has been explained, two or more bumps are stationed in the configuration of arbitration, and when it joins by the mechanism which mechanical damages, such as cratering, generate with a bump's arrangement location when it joins by the conventional ultrasonic-jointing approach, and the junction approach of the invention in this application, the mechanism which such a mechanical damage does not generate is explained. The following two points can be considered as a mechanism which mechanical damages, such as cratering in the conventional ultrasonic impression junction approach, generate.

[0051] Drawing 11 (a) is the mimetic diagram showing the bump array in the corner of the polygon which the bump 12 when mounting the semiconductor device which has stationed the bump 12 in the polygon configuration on a semiconductor chip by ultrasonic jointing on a mounting substrate constitutes. The semiconductor device is substantially [as the structure shown in drawing 1] the same, the bump 12 is formed on the pad 11 formed in the semiconductor chip 10, and the land 21 is formed on the substrate 20 in the mounting substrate. In the A-A' section in drawing, alignment arrangement of the bump 12 is carried out in the supersonic vibration impression direction DV, and as shown in drawing 11 (b) which is a sectional view in A-A' in drawing 11 (a), an oscillation occurs by impression in supersonic vibration also near the mounting substrate front face near the land 21, and near the semiconductor chip substrate front face near the pad 11. Thus, the generated oscillation spreads a mounting substrate or a semiconductor chip substrate, and gives the oscillation of another system with the oscillation directly impressed to the near bump from the ultrasonic horn. It depends for the method of propagation the above-mentioned oscillation on the degree of hardness of a substrate. Therefore, in the supersonic vibration which joins a bump-land plane of composition, the above-mentioned oscillation joins the oscillation told from a direct horn, and the frictional force of a bump-land plane of composition differs from the case where a bump 12 is independently stationed to the supersonic vibration impression direction, as shown in drawing 11 (c) which is a sectional view in B-B' in drawing 11 (a).

[0052] Moreover, at the time of ultrasonic jointing, since the substrate 20 has received thrust, as shown in drawing 11 (b) and (c), a bump 12 and a land 21 will be in the condition that it sinks in a substrate 20. It depends on the degree of hardness of a substrate 20 for this sinking depth. For this reason, near the bump stationed independently near the bump of the endmost part of the bump train by which alignment

arrangement was carried out, Dip R will be formed in the supersonic vibration impression direction on the front face of a substrate 20. On the other hand, dip is not formed in substrate 20 front face near bumps other than the endmost part of the bump train which is shown in drawing 11 (b) and by which alignment arrangement was carried out. It is thought that the above-mentioned dip R affects a bump's oscillation when supersonic vibration is impressed, and the frictional force of a bump-land plane of composition differs by the bump by whom alignment arrangement was done, and the bump stationed independently.

[0053] Since the frictional force of a bump-land plane of composition changes with two causes considered as mentioned above by the bump by whom alignment arrangement was done, and the bump stationed independently, The oscillation which will be impressed on the other hand if one bump-land bonding strength is fully taken becomes strong too much, and mechanical damages, such as cratering, occur. Or if an oscillation is controlled to extent which a mechanical damage does not generate to the bump-land of another side, it will be considered that it becomes impossible to fully take one bump-land bonding strength. Therefore, in order to suppress generating of a mechanical damage about all bumps, it turns out that what is necessary is just to equalize the frictional force which acts on per bump, and reaction.

[0054] Next, in this above-mentioned operation gestalt, the reaction which acts on per bump piece at the time of supersonic vibration impression is equalized, and the mechanism which can prevent mechanical damages, such as cratering, is explained. Drawing 12 (a) is the oscillating impression direction DV about a different direction from any side of the polygon (square) which is the mimetic diagram showing the bump array in the corner of the polygon (square) which the bump 12 when mounting the semiconductor device which has stationed the bump 12 in the polygon configuration (for example, square) on a semiconductor chip by ultrasonic jointing on a mounting substrate constitutes, and a bump 12 constitutes. It has set up. The oscillating impression direction DV in drawing 12 (a) The sectional view in A-A' which is an parallel cross section is drawing 12 (b), and the sectional view in B-B' is drawing 12 (c). As mentioned above, all bumps will be in the same arrangement condition as what is independently arranged to the supersonic vibration impression direction, all bumps will be in the same vibrational state few, and the difference of the bump by whom alignment arrangement was done, and the bump stationed independently of the effect of an oscillation from the approaching bump is lost.

[0055] Moreover, drawing 13 (a) is the mimetic diagram showing bump 12 array when mounting the semiconductor device which carried out alignment arrangement of the bump 12 on the semiconductor chip by ultrasonic jointing on a mounting substrate, and the sectional view in A-A' in drawing 13 (a) is drawing 13 (b), and the sectional view in B-B' is drawing 13 (c). Broken-line R' in drawing 13 (a) shows the edge of the dip R formed in a front face to drawing 13 (b) and the substrate 20 in (c). As shown in

drawing 13 (c), in the cross section of the direction which attached the include angle aslant to the array direction of the bump who did alignment arrangement The include angle of the dip R formed in substrate 20 front face is looser than the cross section in the cross section which intersects perpendicularly to the array direction of the bump who did alignment arrangement, therefore the effect by the dip in the case of an oscillation between the bump by whom alignment arrangement was done, and the bump stationed independently is small. It sets to drawing 7 (d1) and (d2) the shown bump array pattern which was formed into the area pad, and since the bump of an area center section does not need to be thoroughly influenced of the above-mentioned dip R at the time of supersonic vibration impression, she can impress an equal oscillation to all bump-land planes of composition also in the bump array pattern formed into the area pad, and becomes effective [this invention] from the above-mentioned reason.

[0056] It can be said that a different direction from all of a direction parallel to the side of the polygon which the bump arranged in the shape of an abbreviation polygon to the semiconductor device constitutes from a mechanism at the time of the above-mentioned supersonic vibration impression is the direction which equalizes the reaction which acts on per bump piece. Moreover, the direction which equalizes the reaction which acts on per above-mentioned bump piece is the direction DV which in other words impresses supersonic vibration as shown in drawing 14 . It can be said that it is the direction where the distance between the bumps 12 who met (x1, x2, x3 ...) becomes larger than the distance X between the minimum bumps 12.

[0057] Moreover, in case ultrasonic jointing of the bump by whom alignment arrangement was done is carried out to the shape of an abbreviation polygon from the mechanism at the time of the above-mentioned supersonic vibration impression, since the corner of a polygon configuration or the bump near the corner tends to be influenced by other bumps of the dip formed in a substrate front face, it turns out that it is the location which is easy to receive mechanical damages, such as cratering. Therefore, as shown in drawing 15 (a), it is the bump array direction DB. By making the corner of the bump train arranged by the polygon configuration (a drawing top is a square), or the bump near the corner into the dummy bump M with whom only mechanical junction is presented Since a problem does not arise even if cratering occurs by the dummy bump, junction conditions can be optimized so that bonding strength may be carried out to the bump except a corner or its near beyond a predetermined value. Therefore, it is possible to secure bonding strength and to join a bump, without making all the pad sections connected electrically generate mechanical damages, such as cratering, when a substrate with the degree of hardness of a glass epoxy system ingredient etc. low especially as a mounting substrate is used.

[0058] As a bump the corner made into the above-mentioned dummy bump M, or near the corner, as are shown, for example in drawing 15 (b), and shown in the bump of the corner of an array of a bump 12, or drawing 15 (c), it can consider as the bump near the

corner of an array of a bump 12.

[0059] Since ultrasonic energy can be conventionally increased when according to the manufacture approach of above electronic-circuitry equipment impressing supersonic vibration and performing bump junction, even if it is possible to raise die share reinforcement conventionally and it eases the precision of bump height, sufficient bonding strength can be secured, and the rigidity of a production facility and precision which perform ultrasonic jointing can be eased further. Moreover, since the substrate which consists of a glass epoxy system ingredient can be used, the cost of electronic-circuitry equipment is reducible.

[0060] In the 2nd operation gestalt book operation gestalt, the semiconductor device shown in the sectional view of drawing 1 (a) and the top view of drawing 1 (b) is mounted like the 1st operation gestalt. For example, the pad electrode 11 which consists of aluminum etc. is formed so that the periphery section of the electronic-circuitry pattern of the semiconductor chip 10 whose magnitude is 3mmx3mm and whose thickness is about 0.3mm may be surrounded, and it may connect with the above-mentioned electronic-circuitry pattern [near the chip periphery]. The pad electrode 11 above-mentioned forming face is covered by the surface protective coat which consists of the silicon nitride layer or polyimide layer which is not illustrated [for example,], and pad electrode 11 part is carrying out opening. In the above-mentioned opening, the bump 12 who consists of conductors, such as gold, is formed, and it is arranged by the square configuration by arrangement like drawing 6 (a1). For example, in the case of a golden stud bump (99.99% of gold), the bump whose path is 70-80 micrometers and whose height is about 50 micrometers can be formed by the wirebonding method using a golden wire. The number per a bump's semiconductor chip is made into 75 pieces. The semiconductor chip 1 of a peripheral pad mold is constituted as mentioned above.

[0061] nickel , gold , etc. cover the front face of a conductive layer which consist of copper etc. by plating processing , for example , the land (electrode) 21 whose width of face be about 50 micrometers be form in the location corresponding to the bump 12 formation location of the semiconductor device 1 to mount like the 1st operation gestalt by the mounting substrate 2 which mount the above-mentioned semiconductor device 1 on the top face of the substrate 20 which consist of a glass epoxy system ingredient or a ceramic system ingredient . It connects with a land 21 and has the printed-circuit section which is formed on the front face of a substrate 20, a rear face, or both sides etc. and which is not illustrated.

[0062] Since the above-mentioned semiconductor chip is mounted, ultrasonic jointing is carried out using the supersonic vibration impression equipment shown in the ** type block diagram of drawing 16 . The torsional vibration child 4 is attached to the upper part of holder 5a, and, on the other hand, the horn 3 is attached to the lower part of holder 5a. The head lower part of a horn 3 is equipped with bonding tool 3a. The

non-illustrated attraction hole is formed in the semiconductor chip adsorption side at bonding tool 3a, attraction means, such as a pump, are connected to this attraction hole through siphon 3c which is open for free passage to the attraction path inside bonding tool 3a, and this, and it has become the device which can adsorb a semiconductor chip. Flange 5b connects, and is prepared in the part used as the knot of torsional vibration, and bearing bracket 5c is further connected and prepared in holder 5a. Trolley table 6b of vertical driving gear 6a assembles bearing bracket 5c. Moreover, trolley table 6b of vertical driving gear 6a has structure which can apply a load to a drawing up lower part in the condition of having stopped. Above supersonic vibration impression equipment is vertical mold supersonic vibration impression equipment which transmits torsional vibration 4b which made it generate in the torsional vibration child 4 to the semiconductor chip which stuck to the adsorption side at the head of bonding tool 3a.

[0063] How to mount a semiconductor chip 1 in the mounting substrate 2 by ultrasonic jointing using above equipment is explained. First, as shown in drawing 17 , where trolley table 6b is moved above vertical driving gear 6a, a semiconductor chip 1 is supplied to the adsorption side in which adsorption hole 3b of bonding tool 3a is prepared, and by operating an attraction means to by_which it has connected with adsorption hole 3b, such as a pump, as the bump of a semiconductor chip 1 and the land of a mounting substrate counter, the top face of a semiconductor chip 1 is adsorbed according to the above-mentioned attraction side, and it holds.

[0064] Next, the mounting substrate 2 is arranged to the position on a pedestal 7, the location of the bump of a semiconductor chip 1 and the land of the mounting substrate 2 is checked with the optical equipment which is not illustrated, and alignment of a land is performed with a bump. Next, a vertical driving gear is driven, and trolley table 6b is moved until a land touches a bump. At this time, as shown in drawing 16 , the load of the magnitude set up beforehand is applied to a drawing up lower part by migration of trolley table 6b. By this, the head of the bump of a semiconductor chip 1 will be forced on the land of the mounting substrate 2 by the predetermined load P.

[0065] Next, torsional vibration child 4a is made to drive, and torsional vibration 4b is generated. Torsional vibration 4b is transmitted through holder 5a, a horn 3, and bonding tool 3a, and impresses the torsional vibration to Direction DTW to a semiconductor chip 1. Since holder 5a is the location of the knot of torsional vibration at this time, even if torsional vibration occurs, near the holder 5a, the amplitude of torsional vibration is stopped small.

[0066] Drawing 18 (a) is the side elevation which expanded the semiconductor chip part when impressing the torsional vibration to Direction DTW to the above-mentioned semiconductor chip 1, and drawing 18 (b) is an important section top view. A pressure P is impressed to the top face of a semiconductor chip 1 by bonding tool 3a, and the supersonic vibration which carries out torsional vibration in the direction DTW by torsional vibration child 4a connected to the horn 3 where a bump 12 and a land 21 are

stuck is generated. While a horn 3 amplifies the amplitude of Direction DTW at this time, supersonic vibration is impressed to the adhesion part of a land 21 with a bump 12.

[0067] In the above, frictional heat occurs in the adhesion part of a land 21 with a bump 12 by having impressed supersonic vibration. The affix and oxide film which are formed in the front face of a land 21 with the bump 12 are destroyed by this friction, and a front face is graduated by it. Furthermore, it is crushed under the effect of a load and an oscillation, and deforms, a bump 12 and a land 21 generate heat under the effect of the heat by friction at the last, and solid state welding of the bump 12 is carried out by counter diffusion or diffusion. Thus, the electronic-circuitry equipment which mounted the semiconductor device 1 as shown in drawing 4 (b) which is the sectional view and its important section enlarged drawing of the same drawing 4 (a) as the 1st operation gestalt in the mounting substrate 2 can be manufactured.

[0068] Since generation of heat by friction emits rapidly through the top face of a semiconductor chip, the internal extension of a mounting substrate, etc. when the wiring width of face of the wiring section of a mounting substrate is large, the case of magnitude in which the magnitude of a semiconductor chip 1 exceeds 10mm angle, and, the temperature of the plane of composition of a land does not fully rise with a bump, and solid state welding may not be performed. As this cure, divergence of the frictional heat at the time of supersonic vibration impression can be effectively prevented by warming beforehand bonding tool 3a or a pedestal 7 to about 100-200 **s.

[0069] (Modification) The optimal load for ultrasonic jointing is around about 100g per bump. For this reason, if the number of the bumps per semiconductor chip increases, the load applied to a semiconductor chip must be increased. Consequently, the static-friction force of a semiconductor chip and a mounting substrate increases. Generally, if the number of bumps exceeds 200 per semiconductor chip, even if it impresses torsional vibration to a semiconductor chip with a supersonic wave, slipping and friction may not occur between a bump's head and a land. In such a case, it is desirable to use the vertical mold supersonic vibration impression equipment shown in drawing 19 . Although it is the same as that of the equipment substantially shown in drawing 16 , it differs that torsional vibration child 4a is the coupling oscillation child who can generate perpendicular-vibration (oscillation of direction of normal over mounting substrate) 4c other than torsional vibration 4b. It is possible for perpendicular-vibration 4c other than the above-mentioned torsional vibration 4b to be transmitted to a bonding tool, and for the torsional vibration to Direction DTW and the perpendicular vibration to Direction DVT to occur, and to generate sliding friction stabilized between a bump's head and the land. The above-mentioned approach is effective especially when comparatively soft substrates, such as glass epoxy, are used as a mounting substrate ingredient.

[0070] According to this above-mentioned operation gestalt, being able to equalize the reaction which acts on per bump piece at the time of supersonic vibration impression

like the 1st operation gestalt, preventing mechanical damages, such as cratering, and securing bonding strength, a bump can be joined and electronic-circuitry equipment can be manufactured.

[0071] Moreover, by the manufacture approach of the electronic-circuitry equipment concerning this operation gestalt, since a horn 3 and torsional vibration child 4a be arrange in the right above [a semiconductor chip 1] direction, when a load be apply to a semiconductor chip 1, the fault which the ultrasonic impression equipment of the conventional piece support type that a horn 3 bend and the parallelism of a semiconductor chip 1 and the mounting substrate 2 change have can be solve. Moreover, the vertical mold supersonic vibration impression equipment used in this operation gestalt also has the advantage that a design and a fabrication are easier than the supersonic vibration impression equipment of both the conventional support type.

[0072] Also in this operation gestalt, it is applicable to the bump array pattern of various configurations as well as the 1st operation gestalt.

[0073] In the manufacture approach of the electronic-circuitry equipment of this invention, if it is semiconductor devices, such as an MOS transistor system semiconductor device, bipolar **********, a BiCMOS system semiconductor device, and a semiconductor device that carried logic and memory, as a semiconductor device mounted on a mounting substrate, it is applicable even to what.

[0074] The manufacture approach of the electronic-circuitry equipment of this invention is not limited to the gestalt of the above-mentioned operation. For example, ingredients other than gold may be used as a bump. The arrangement part of a pad electrode is not limited to the peripheral section of a semiconductor chip. The oscillating direction of supersonic vibration can be set up in any direction in which the reaction which acts on per bump piece besides the direction of the diagonal line of a semiconductor chip is equalized. In addition, modification various in the range which does not deviate from the summary of this invention is possible.

[0075]

[Effect of the Invention] As mentioned above, it is possible to secure bonding strength and to join a bump, without making all the pad sections connected electrically generate mechanical damages, such as cratering, according to the manufacture approach of the electronic-circuitry equipment of this invention, when a substrate with the degree of hardness of a glass epoxy system ingredient etc. low especially as a mounting substrate is used.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] Drawing 1 (a) is the sectional view of the semiconductor device mounted in the 1st operation gestalt, the 2nd operation gestalt, and the conventional example, and drawing 1 (b) is a top view.

[Drawing 2] Drawing 2 (a) is the side elevation of the process which mounts a semiconductor device in the 1st operation gestalt, and drawing 2 (b) is an important section top view.

[Drawing 3] Drawing 3 is a mimetic diagram explaining how to attract a semiconductor device and to adsorb it so that the oscillating direction of supersonic vibration and a bump's array direction may serve as a predetermined include angle in the 1st operation gestalt.

[Drawing 4] Drawing 4 (a) is the sectional view of electronic-circuitry equipment which manufactured in the 1st operation gestalt and the 2nd operation gestalt, and drawing 4 (b) is an important section enlarged drawing.

[Drawing 5] Drawing 5 is a sectional view explaining how to measure die share reinforcement.

[Drawing 6] Drawing 6 (a1) is a mimetic diagram in which a bump shows the bump array pattern arranged by the rectangle configuration in one train at the periphery section of a semiconductor chip, and drawing 6 (a2) is the C section enlarged drawing. Drawing 6 (b1) is a mimetic diagram in which a bump shows the bump array pattern arranged by the rectangle configuration in two or more trains at the periphery section of a semiconductor chip, and drawing 6 (b2) is the C section enlarged drawing. Drawing 6 (c1) is a mimetic diagram a bump indicates one train of ****** bump array patterns to be at a time to a rectangle configuration in the periphery section and the center section of the semiconductor chip, respectively, and drawing 6 (c2) is the C section enlarged drawing.

[Drawing 7] Drawing 7 (d1) is the mimetic diagram showing the bump array pattern with which a bump is stationed all over a semiconductor chip, and which was formed into the area pad, and drawing 7 (d2) is the C section enlarged drawing. Drawing 7 (e) is a mimetic diagram in which a bump shows the bump array pattern arranged by 8 square-shape configuration in one train at the periphery section of a semiconductor chip.

[Drawing 8] Drawing 8 (f) is a mimetic diagram in which a bump shows the abbreviation rectangle configuration pattern with which some bumps are removed by the rectangle configuration in the bump array pattern arranged in one train at the periphery section of a semiconductor chip, and drawing 8 (g) is a mimetic diagram in which a bump 12 shows the bump array pattern arranged by one train in the shape of linear.

[Drawing 9] Drawing 9 is the mimetic diagram showing the example of the direction of supersonic vibration over the bump array arranged at the polygon configuration, as shown in drawing 9 (a2) to the bump array of the square configuration shown in drawing 9 (a1), it can set up the direction of supersonic vibration, and as shown in

drawing 9 (b2) to the bump array of the equilateral-triangle configuration shown in drawing 9 (b1), it can set up the direction of supersonic vibration.

[Drawing 10] Drawing 10 is the mimetic diagram showing the example of the direction of supersonic vibration in the case of dividing into multiple times and impressing supersonic vibration for every direction which intersects perpendicularly with each side of the polygon which the bump arranged in the shape of an abbreviation polygon constitutes, and, as for drawing 10 (b), in the bump array of a square configuration, drawing 10 (a) shows the case of the bump array of 8 square-shape configuration.

[Drawing 11] The mimetic diagram showing the bump array in the corner of the polygon from which a bump constitutes drawing 11 (a) in case drawing 11 mounts the semiconductor device which has stationed the bump in the polygon configuration on a semiconductor chip by ultrasonic jointing of the conventional approach on a mounting substrate, a sectional view [in / in drawing 11 (b) / A-A' in drawing 11 (a)], and drawing 11 (c) are the sectional views in B-B' in drawing 11 (a).

[Drawing 12] The mimetic diagram showing the bump array in the corner of the polygon from which a bump constitutes drawing 12 (a) in case drawing 12 mounts the semiconductor device which has stationed the bump in the polygon configuration on a semiconductor chip by ultrasonic jointing of this invention on a mounting substrate, a sectional view [in / in drawing 12 (b) / A-A' in drawing 12 (a)], and drawing 12 (c) are the sectional views in B-B' in drawing 12 (a).

[Drawing 13] The mimetic diagram in which drawing 13 (a) for drawing 13 to explain that the reaction which acts on per bump piece by this invention is equalized shows a bump array, a sectional view [in / in drawing 13 (b) / A-A' in drawing 13 (a)], and drawing 13 (c) are the sectional views in B-B' in drawing 13 (a).

[Drawing 14] Drawing 14 is a mimetic diagram for explaining that the reaction which acts on per bump piece by this invention is equalized.

[Drawing 15] A bump array in case drawing 15 (a) in case drawing 15 makes a dummy bump the corner of the polygon which the bump arranged in the shape of an abbreviation polygon constitutes, or the bump near the corner considers the bump of a corner as a mimetic diagram and drawing 15 (b) considers as a dummy bump, and drawing 15 (c) show the bump array in the case of making the bump near the corner into a dummy bump.

[Drawing 16] Drawing 16 is the ** type block diagram of the vertical mold supersonic vibration impression equipment used in the 2nd operation gestalt.

[Drawing 17] Drawing 17 is the ** type block diagram showing the process which makes a semiconductor chip stick to the vertical mold supersonic vibration impression equipment shown in drawing 16 .

[Drawing 18] Drawing 18 (a) is the side elevation which expanded the semiconductor chip part when impressing torsional vibration to the semiconductor chip, and drawing 18 (b) is an important section top view.

[Drawing 19] Drawing 19 is the ** type block diagram of the modification of the vertical mold supersonic vibration impression equipment used in the 2nd operation gestalt.

[Drawing 20] Drawing 20 (a) is the side elevation of the process which mounts a semiconductor device in the conventional example, and drawing 20 (b) is an important section top view.

[Drawing 21] Drawing 21 is the sectional view of electronic-circuitry equipment which manufactured in the conventional example.

[Drawing 22] Drawing 22 is a sectional view for explaining the trouble concerning the conventional example.

[Description of Notations]

1 [-- Heights (bonding tool),] -- A semiconductor device, 2 -- A mounting substrate, 3 -- A horn, 3a 3b [-- A torsional vibration child, 4b / -- Torsional vibration,] -- An attraction hole, 3c -- The siphon, 4 -- Vibrator, 4a 4c [-- Bearing bracket,] -- Perpendicular vibration, 5a -- A holder, 5b -- A flange, 5c 6a [-- Semiconductor chip,] -- A vertical driving gear, 6b -- A trolley table, 7 -- A pedestal, 10 11 [-- An electrode and DV (DV1, DV2 DV3),] -- A pad electrode, 12 -- A bump, 20 -- A substrate, 21 DTW, DVT [-- A crack, M / -- A dummy bump, P / -- A pressure, R / -- Dip.] -- The oscillating direction and DB -- (DB1, DB2, DB3) The bump array direction, J -- The pawl for die share on-the-strength measurement, K